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FINAL

TECHNICAL MEMORANDUM FOR RECORD

To	HQMC (LFL) / MCICOM (GF-EV) REVA Program File
CC	NAVFAC Atlantic REVA Program Manager
Subject	Range Environmental Vulnerability Assessment (REVA) Periodic Review Documentation of Findings for Marine Corps Base (MCB) Hawaii
From	(b) (6) Project Manager AECOM Technical Services Inc.
Date	November 19, 2020

Executive Summary

This REVA Periodic Review for Marine Corps Base (MCB) Hawaii assessed the munitions training operations conducted since the previous REVA review was completed in 2013, to determine if there are changes that may impact range sustainability due to off range migration of munitions constituents (MC). Data gathered for the Conceptual Site Model (CSM) update indicate that pathways for MC migration from the MCB Hawaii source areas to off range receptors are incomplete. There is no known off range migration of MC that presents a potential unacceptable risk to human health or the environment.

A variety of munitions training occurs at MCB Hawaii, ranging from firing small arms to training with medium and large caliber high explosives (HE) items. Operational ranges are located at three facilities on Oahu: Kaneohe Bay Range Training Facility (KBRTF), Puuloa Range Training Facility (PRTF), and Marine Corps Training Area Bellows (MCTAB). Live fire occurs at KBRTF and PRTF, while only practice, blank, and simulator munitions are used at MCTAB. KBRTF has HE use at one dud-producing impact area and one non-dud-producing impact area as well as small arms use at several ranges. PRTF has only small arms ranges.

The REVA team evaluated munitions expenditures (MC source) at MCB Hawaii. There was an overall increase from the previous review period to the current review period for small arms expenditures, which is attributed to increased training at KBRTF. Small arms range design and maintenance (e.g., use of bullet traps, well-vegetated berms, frequent lead mining and berm refacing) significantly reduce the MC source and limit off range migration. Expenditures of HE munitions increased from the previous review period to the current review period; however, overall use of HE items at KBRTF is relatively low. Expenditures of perchlorate-containing munitions decreased from the previous to the current review period, and overall use of perchlorate-containing items at KBRTF is relatively low. Due to the absence of a substantial MC source, the CSM pathways are incomplete at MCTAB.

The most likely transport mechanisms for MC from the ranges or impact areas to off range locations (bay/ocean) are via stormwater runoff and infiltration to groundwater. At KBRTF, conditions conducive to MC migration (especially from unvegetated areas) into the Kailua Bay via stormwater runoff include low to moderate rainfall totals, steep topography, and soils with high runoff potential and low to moderate erodibility. At PRTF, low to moderate rainfall totals and surface soils with high permeability are conducive to infiltration of MC to shallow groundwater with subsequent discharge to the ocean. Offshore areas at both facilities are subject to tidal mixing. The aquifers underlying both KBRTF and PRTF are designated as nondrinking water aquifers.

Human and ecological receptors at the off range areas of KBRTF and PRTF include nearby recreational users and occasional visiting endangered species. Public recreational use in the Kailua Bay at KBRTF is restricted to areas beyond 500-yards from the shoreline. Public recreational use of the beach behind the berms at PRTF is prohibited, but recreational users are present on the shore east and west of PRTF. Native Hawaiians may harvest edible limu from the nearshore areas west of PRTF. The Hawaiian monk seal (endangered) has been observed occasionally at the KBRTF. The pueo (endangered) may occasionally use the area for hunting, and the Hawaiian monk seal (endangered) and Hawaiian green sea turtle (threatened) occasionally haul out on the shoreline at PRTF.

As part of the CSM update analysis, the REVA team compared the current conditions to the findings of the previous REVA review, which included pathway screening-level modeling at KBRTF. Average annual MC concentrations at KBRTF off range receptor locations were predicted to be either below detection levels or below screening criteria. While explosives use at the KBRTF did increase since the previous review, the increase is not sufficient to significantly change the modeled results. At MCTAB, expenditures during the previous review were very low (i.e., not enough MC source to carry through to modeling potential off range concentrations). Current range use is similar. Due to the absence of a substantial MC source, the CSM pathways are incomplete at MCTAB. While no immediate threat is identified at PRTF, the six SAR impact berms are within 100 feet of the Pacific Ocean, and there are no additional structures or protections between the berms and the beach. Future shoreline erosion could cause the off range release of lead from the impact berms into the ocean. An Environmental Assessment was conducted in 2019 to initiate measures to mitigate coastal erosion at PRTF.

CSM findings indicate that there is no off range migration of MC that presents a potential unacceptable risk to human health or the environment at MCB Hawaii. No further assessment (e.g., sampling, modeling) is recommended at this time under the REVA program. All ranges will be evaluated during the next REVA Periodic Review, or sooner if determined appropriate due to a change in site conditions (e.g., increased MC loading or identification of new receptors). A summary of these findings, in the form of the MCB Hawaii REVA Factsheet (Enclosure 1), will be published on the DoD Environment, Safety and Health Network and Information (DENIX) website (https://www.denix.osd.mil/orap/home/).

1 Introduction

This Documentation of Findings for the United States Marine Corps (USMC) Range Environmental Vulnerability Assessment (REVA) Program assesses munitions use that occurred at Marine Corps Base (MCB) Hawaii from calendar years 2014 through 2019.

1.1 Purpose of REVA

The purpose of the REVA Program is to ensure continued sustainability and usability of USMC training ranges. Under the REVA program, per Department of Defense (DoD) Instruction

4715.14 (DoD, 2018), the USMC evaluates whether there is a release or substantial threat of a release of munitions constituents (MC) from an operational range to off range areas. If a release is identified, the evaluation determines if it creates an unacceptable risk to human health or the environment.

1.1.1 Munitions Constituents (MC)

The REVA program focuses on the most common and mobile MC found on USMC ranges, referred to as indicator MC. The REVA indicator MC are lead; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX); hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX); 2,4,6-trinitritoluene (TNT); and perchlorate.

Metals associated with small arms include lead, antimony, copper, and zinc. REVA focuses on lead as the MC indicator because it is primarily associated with small arms munitions, and it is the most prevalent metal found in soils on operational ranges. Lead has been shown to have limited vertical migration potential through soil matrices; however, like many contaminants, lead has the potential to migrate when in surface water media. Many studies have indicated that metallic lead (such as recently fired, unweathered bullets and shot) generally has low chemical reactivity and low solubility in water, and it is relatively inactive in the environment under most ambient conditions. However, lead deposited on a range may become mobile in certain conditions (e.g., acidic soils, shallow groundwater, soils with low cation exchange capacity [i.e., lead does not easily bind to soil], high erosion rates, and proximity to surface waters) (Clausen et al. 2007, Cao et al. 2003).

Among the explosive MC, REVA focuses on TNT, HMX, and RDX. Perchlorate is also evaluated as a component in some propellants and pyrotechnics. These MC are the most frequently detected explosive constituents at training ranges and can persist in the environment (Jenkins, Bartolini, and Ranney, 2003). Studies have shown that high explosives (HE) components RDX and HMX, as well as perchlorate, are the most mobile within the environment and have the highest potential to migrate off range (Jenkins, 2005).

1.1.2 Off Range

Off range areas are outside the operational range complex. For purposes of this assessment, operational range complexes include operational range boundaries, impact areas, and training areas. The off range area closest to the operational range complex boundary may be outside the installation boundary or on installation property, such as cantonment areas.

Per DoD Instruction 4715.14 (DoD, 2018), the REVA Program uses a CSM to evaluate current or potential off range MC migration (i.e., off range MC source-receptor interaction). A CSM pathway consists of an MC source, transport mechanism from the MC source to an off range exposure media (i.e., groundwater, surface water, sediment, and soil), and receptor interaction with the off range exposure media.

- Source: includes MC deposition on the ranges (primary source) and a release mechanism (e.g., dispersion, adsorption, or dissolution) to surface soil and/or surface water (secondary source/media).
- Transport mechanism: includes surface water infiltration or percolation to groundwater; stormwater runoff that transports surface soil to surface water, sediment, or surface soil; and surface water transport via current/flow/hydraulic connection to surface water or sediment.
- Receptors: include humans or biota with interactions to media via ingestion, incidental ingestion, or dermal contact.

A CSM pathway can be complete, incomplete, or inconclusive.

- Complete: there is a viable connection between all the CSM pathway components, which results in an off range receptor interacting with MC in off range exposure media.
- Incomplete: one or more CSM components is not viable, which results in no interaction between an off range receptor and MC in off range exposure media.
- Inconclusive: additional data are needed to determine whether the CSM pathway is complete or incomplete.

1.1.3 Risk Evaluation

If a CSM pathway is complete, then initial risk screening is performed by comparing the MC concentration in off range environmental media (e.g., surface water, groundwater, sediment) to media- and receptor-specific regulatory values. The REVA Program focuses on comparison of MC concentration data to state-specific regulatory values, as states typically are the primary regulating authority for environmental compliance on USMC installations. If state regulatory values are unavailable, then federal regulatory values may be used. In the event that the MC do not have established federal or state regulatory values, the REVA team will utilize established federal and state screening values to determine if additional information is needed or if MC concentrations require further risk evaluation. Screening values are selected from a hierarchy of scientific sources with recognized authority, acceptance, and applicability. Additional risk evaluation may be performed, as outlined in the REVA Periodic Review Guidance Manual (USMC, 2018).

1.2 Objectives of Periodic Review

Every five years, or sooner if changes in range use or conditions warrant, the USMC assesses the ranges at each of its installations in accordance with the DoD Instruction 4715.14 (DoD, 2018) and the REVA Periodic Review Guidance Manual (USMC, 2018). The periodic review assesses munitions training operations conducted since the last review to determine if there is a substantial threat or occurrence of off range MC migration that creates an unacceptable risk to human health or the environment.

AECOM, as part of the REVA Technical Support Team, was tasked under Contract N62470-16-D-9002, Delivery Orders N6247018F4028 and N6247019F4044, to implement the REVA Program Periodic Reviews for selected operational ranges, including Marine Corps Installations Pacific Region (MCIPAC) MCB Hawaii. This Periodic Review covers munitions use that occurred at MCB Hawaii from 2014 through 2019 (previous REVA reviews covered munitions training through 2013).

1.3 Objectives of CSM Update

The first step of the Periodic Review is to update the CSM for operational ranges and range complexes. Existing site data are reviewed to identify potential MC sources, transport mechanisms, and off range receptors. If there is sufficient evidence to conclude there are no source-receptor interactions (i.e., incomplete CSM pathways), then conclusions are documented in the REVA Periodic Review Documentation of Findings (consisting of a technical memorandum and factsheet), and the assessment is complete. Pathways identified as complete or inconclusive will proceed to further assessment (e.g., sampling, modeling) prior to preparation of the Documentation of Findings.

The current CSM for MCB Hawaii is discussed in detail in Section 4.

2 MCB Hawaii Overview

The mission of MCB Hawaii is to provide "forward-based, sustainable and secure training and operational support, facilities, and services to enable Operational Forces to accomplish their mission" (USMC, 2020a).

2.1 Location

MCB Hawaii consists of approximately 4,500 acres over several discrete noncontiguous properties located on the islands of Oahu and Molokai. Operational ranges are located at three facilities: MCB Hawaii Kaneohe Bay, Puuloa Range Training Facility (PRTF), and Marine Corps Training Area Bellows (MCTAB) (USMC, 2014). All three facilities are located on Oahu (Figure 1). The primary and largest facility (almost 3,000 acres) is MCB Hawaii Kaneohe Bay, which is located on the eastern side of Oahu, approximately 12 miles northeast of Honolulu, at the end of Mokapu Peninsula. PRTF is located on the southern side of Oahu, along the eastern edge of Ewa Beach, near the entrance to Pearl Harbor. MCTAB is located on the eastern shore of Oahu, approximately eight miles south of MCB Hawaii Kaneohe Bay.

2.2 Munitions Use

A variety of munitions training (from small arms to HE use) occurs at MCB Hawaii in three geographically separate operational range areas. At MCB Hawaii Kaneohe Bay, the operational range training area known as Kaneohe Bay Range Training Facility (KBRTF) is located inside the Ulupau Crater. It has dudded and non-dudded impact areas for ranges accommodating mortar, rocket, and grenade live-fire exercises; a demolition range used for training and emergency destruction of ordnance; and several small arms and instructional ranges (Figure 2a). There are no HE fixed ranges or impact areas located at PRTF or MCTAB. PRTF is used only for small arms training at six fixed ranges (Figure 2b). MCTAB is mostly used for maneuver operations and military operations in urban terrain (MOUT) training at three MOUT sites (Figure 2c); REVA indicator MC in expenditures is negligible. Individual ranges for the current review period are discussed in Section 4.1.

3 Summary of Previous REVA Review Findings

A REVA Baseline Assessment and Five-year Review were previously conducted at MCB Hawaii. Both studies concluded that range operations did not pose a known unacceptable risk to human health or the environment. The initial study (Baseline Assessment) was completed in 2009 and documented munitions use from when the ranges were first used through 2007 (USMC, 2009). The most recent report was the *Range Environmental Vulnerability Assessment 5-Year Review, Marine Corps Base Hawaii*, which evaluated munitions use from 2008 through 2013 (USMC, 2014). A summary of the Five-year Review is provided in the following subsections.

3.1 Operational Ranges

For the Five-year Review, nine MC loading areas (i.e., MC source/deposition areas) were delineated based on the locations of ranges, targets, and munitions use. Four of the MC loading areas were at the KBRTF and five were at MCTAB. Additionally, ten SARs were used and assessed during the review period (four at KBRTF and six at PRTF).

3.2 MC Loading Area Screening Level Modeling and Sample Collection

KBRTF is a multipurpose range complex that supports a variety of live-fire training exercises. The four KBRTF MC loading areas in the Five-year Review were HE (Dudded) Impact Area, Inert (Non-Dudded) Impact Area, R-8, and R-8A. They were grouped by drainage areas, with the two impact areas belonging to one drainage area, and the two ranges belonging to the other drainage area.

MCTAB is used for maneuver area, MOUT training, landing zones, and improvised explosive device (IED) training. Blank and special effects small arms marking system (SESAMS) are the primary types of training items used at MCTAB. No live fire, HE, or aerial pyrotechnic munitions are authorized for use. The five MCTAB MC loading areas were MOUT 1, MOUT 2, MOUT 3, TA-2, and TA-3. They were evaluated for the initial modeling stages, but the MC source was very low. Therefore, modeling and sampling were unnecessary and not conducted for the MCTAB MC loading areas during the Five-year Review.

Screening-level transport analyses (i.e., modeling) of sediment, surface water, and groundwater were performed for the four MC loading areas in two drainage areas at KBRTF to predict average annual concentrations of MC at the edge of the MC loading area and at the off range receptor locations in Kailua Bay. The model predicted average annual MC concentrations at receptor locations to be either below detection levels or below screening criteria (USMC, 2014). Table 3-1 provides a summary of the Five-year Review analyses and conclusions/recommendations for each.

Table 3-1: Summary of REVA Five-Year Review Screening-Level Assessment Results (USMC, 2014)

<table>
<tr><th rowspan="2">MC Loading Areas (Drainage Area)</th><th rowspan="2">Media</th><th colspan="2">Modeled Screening-Level Assessment Average Annual MC Concentrations[1]</th><th rowspan="2">Conclusion/ Recommendation</th></tr>
<tr><th>Human Receptor Location[2]</th><th>Ecological Receptor Location[3]</th></tr>
<tr><td rowspan="3">HE/ Inert Impact Area (KBRTF)</td><td>Sediment</td><td>Not detectable</td><td>Not detectable</td><td rowspan="7">No immediate threat to identified receptors.

No further assessment (e.g., sampling) required for Five-year Review.</td></tr>
<tr><td>Surface Water</td><td>Not detectable</td><td>Below screening criteria</td></tr>
<tr><td>Groundwater</td><td colspan="2">MC transport via groundwater was modeled, and receptor exposure was captured in surface water</td></tr>
<tr><td rowspan="3">R-8/
R-8A (KBRTF)</td><td>Sediment</td><td>Not detectable</td><td>Not detectable</td></tr>
<tr><td>Surface Water</td><td>Not detectable</td><td>Below screening criteria</td></tr>
<tr><td>Groundwater</td><td colspan="2">MC transport via groundwater was modeled, and receptor exposure was captured in surface water</td></tr>
<tr><td>MOUT 1, MOUT 2, MOUT 3, TA-2, and TA-3 (MCTAB)</td><td>-</td><td colspan="2">Modeling not conducted due to very low MC source</td></tr>
</table>

[1] MC included HMX, RDX, TNT, and perchlorate.
[2] Human receptors at KBRTF beyond the 500-yard restricted area in Kailua Bay.
[3] Ecological receptors at KBRTF in the nearshore area of Kailua Bay.

As summarized in Table 3-1, the four KBRTF MC Loading Areas (via two primary drainage area pathways) were evaluated in the Five-year Review for off range transport of indicator MC (RDX, HMX, TNT, and perchlorate). For human receptors at the off range boundary (500-yards from the shoreline in Kailua Bay), modeling results for both drainage areas indicated that MC was not detectable. For ecological receptors in the nearshore area of the Kailua Bay, modeling results for both drainage areas indicated that MC would not be detectable in sediment but may be detectable below screening criteria in surface water. Modeling results were based on conservative assumptions, and explosives and perchlorate concentrations entering Kailua Bay

would likely be reduced to levels below detection limits in regions of the bay much closer to the point of discharge than was predicted in the model. For example, the HE (Dudded)/Inert (Non-Dudded) Impact Area drainage area was considered as a concentrated point source discharge as opposed to a more likely diffuse runoff pattern. Additionally, the model did not input tidal influences in the bay (further mixing) or consider MC chemical breakdown and decay. For the R-8/R-8A MC loading area, modeling predicted that the detectable concentrations of MC were at least three orders of magnitude lower than their respective marine surface water screening values.

3.3 Small Arms Range Assessment Protocol (SARAP)

In the Five-year Review, SARs were assessed qualitatively via the SAR Assessment Protocol (SARAP). The SARAP evaluated characteristics of a range using weighted criteria to calculate a score to determine if there was a possible threat of a release of lead from the SAR through surface water or groundwater transport.[1]

Twelve SARs were identified at MCB Hawaii during the Five-year Review. However, two of these (R-8B and R-10) were not evaluated via the SARAP due to their limited use and/or no expenditure data recorded in RFMSS from 2008 to 2013. The remaining ten SARS evaluated via the SARAP were: R-1, R-2, R-6, and R-9 at KBRTF and Alpha, Bravo, Charlie, Delta, Echo, and Foxtrot at PRTF. A summary of the rating categories and ratings for the Five-year Review SARAP evaluations are provided in Table 3-2.

Table 3-2: REVA Five-year Review SARAP Rating Summary (USMC, 2013)

Rating	Rating Description	Number of Evaluations		Conclusion
		Surface Water	Groundwater	
Minimal	SAR(s) have minimal or no potential for lead migration to a receptor	2	10	Minimal or no concern for lead migration and minimal environmental concern
Moderate	SAR(s) may have the potential for lead migration to a receptor	7	0	Likely not an immediate environmental concern
High	SAR(s) have high potential for lead migration to a receptor	1	0	Greatest level of environmental concern and requires additional action
TOTAL		**10**	**10**	**-**

Foxtrot range at PRTF received the only high surface water SARAP rating due to the long duration of use, high lead loading, and no regular range maintenance program. During the Five-year review, these characteristics were driving the threat of an imminent release of MC into the ocean from the partially eroded impact berm, which is situated on the shoreline. Current range management activities and best management practices implemented since that time addressed this threat, as discussed Section 4.1.3. The moderate surface water SARAP ratings were associated with the remaining ranges at PRTF as well as R-1 and R-9 at KBRTF. For the Ranges Alpha through Echo at PRTF, a variety of factors contributed to the ratings including high lead loading, no regular range maintenance program, long duration of use, only partial

[1] Per the REVA Guidance Manual updates, the SARAP process, which was used during the Baseline and Five-year Reviews, is no longer used. For this current review and onward, SARs are evaluated using the same process as other operational ranges and may be assessed both qualitatively and quantitatively, if appropriate, in accordance with the REVA processes.

stormwater engineering controls and a steep impact berm at Alpha and Bravo, and lack of vegetation at Charlie and Delta. For R-1 and R-9 at KBRTF, the moderate surface water ratings were due to the lack of a regular range maintenance program, long duration of range use, moderate lead loading, no stormwater engineering controls, the presence of nearby ecological receptors at R-1, and high lead loading and partial stormwater engineering controls at R-9. The minimal surface water SARAP ratings were associated with R-2 and R-6 at KBRTF. Even though the average lead loading was high at both ranges, the minimal ratings were due to several factors, including effective runoff/erosion controls, well vegetated range floors and side berms, and maintained bullet traps.

Groundwater pathways for all 10 ranges were rated minimal in the SARAP. No groundwater receptors or exposure points were identified near KBRTF or PRTF. Additional factors that contributed to minimal ratings at KBRTF included high clay content in the soil and presence of bullet traps (R-2 and R-6). Although a shallow groundwater table and sandy soil are present at PRTF, groundwater discharges to the ocean near the ranges and mixes with ocean water (USMC, 2014).

3.4 Five-year Review Recommendation

The Five-year Review concluded that there was no immediate threat to identified receptors in Kailua Bay from the four KBRTF MC Loading Areas. SARAP results of “minimal” and “moderate” for most of the SARs indicated no immediate threat to human health or the environment. The SARAP result of “high” for surface water at the Foxtrot range at PRTF was due to berm erosion issues (USMC, 2014). Work was completed at the range to address this concern, and current conditions at Foxtrot range are presented in Section 4 (see Sections 4.1.1.2 and 4.1.3.2), with a shoreline erosion discussion in Section 4.2.1.4.

4 CSM for Current REVA Review Period

This CSM update incorporates information collected during the previous REVA study and updated data collected for this study. The REVA Technical Support Team reviewed CSM information from the previous REVA reports, focusing primarily on the most recent report (i.e., Five-year Review) to determine where updated data inputs were necessary. New information was gathered to capture changes that have occurred since 2013, focusing on operational ranges (e.g., range inventory, expenditures, changes in use/design) and receptors (e.g., new developments, ecological). Per recent REVA Manual updates, the SARAP process was eliminated, and SARs are evaluated using the same process as other operational ranges.

The REVA Technical Team held a kickoff meeting with MCB Hawaii on 9 July 2019 to speak with installation personnel about the REVA process and initiate data collection. Updated information for the MC source areas was gathered from the following USMC sources: RFMSS (USMC, 2020b), GeoFidelis (the USMC Installation Geospatial Information and Services [IGI&S] program for Installation and Environmental geospatial products and services) (USMC, 2019b), and installation environmental and range documents. The REVA Team conducted a site visit 8-9 January 2020 of the MCB Hawaii (including KBRTF, MCTAB, and PRTF) during which installation personnel were interviewed and the ranges were toured.

A summary of the current source, transport mechanisms, and off range receptors for MCB Hawaii are presented in the following sections. The tabular CSMs for MCB Hawaii are presented as Figures 3a through 3c. The CSM pathways are incomplete. Off range migration of MC does not pose a risk to human or ecological receptors.

4.1 Primary Source Areas (Ranges)

A CSM source includes MC deposition on the ranges (primary source). Munitions expenditure data was queried from RFMSS for each range at KBRTF and PRTF that was operational during the current review period (2014-2019) (USMC, 2020b). In accordance with DoD Instruction 4715.14 (DoD, 2018), expenditures associated with indoor ranges were not assessed (i.e., R-3 at KBRTF). Expenditures associated with practice, blank, and simulator munitions that have no or minimal MC source are not included in the MC source discussion.

MCTAB has three training areas and three MOUT facilities. Only practice, blank, and simulator munitions are used at MCTAB, and historical expenditures were very low. The Five-year Review concluded that due to low munitions expenditures, the MC source was not significant enough to warrant further evaluation. It further concluded that there was no release or substantial threat of a release of munitions constituents (MC) from the operational range or range complex areas to off range areas at MCTAB. No current expenditure data was provided for the MCTAB facility, but current range use is similar. A viable MC source is not present due to overall low use of practice, blank, and simulator munitions. The CSM pathways for MC to migrate from the range to off range receptors are incomplete. The previous REVA review conclusions are still valid. No further evaluation of MCTAB is necessary under this REVA Periodic Review.

4.1.1 Range Layout

The general configurations for ranges at KBRTF and PRTF are described below.

4.1.1.1 KBRTF

KBRTF has eleven ranges where live fire currently occurs. The ranges are located within the Ulupau Crater, which is the remnant of a cinder cone volcanic feature. KBRTF is bounded on the south, west, and north by steep mountain walls (Ulupau Head). The eastern side of the crater feature historically eroded into the Pacific Ocean and is bounded by a steep cliff dropping down to a sand beach and the ocean. The north-northeastern portion of KBRTF is Mokapu Point and the Ulupau Wildlife Management Area (WMA). Just south/downhill of the WMA are the Non-Dudded Impact Area and Dudded Impact Area. The current uses of each range at KBRTF are presented in Table 4-1.

Table 4-1: KBRTF Current Range Layout (USMC, 2014 and 2020b)

Range	Current Use		Notes
	Small Arms	HE	
R-1	Yes	-	KD rifle and fire from towers into SACON® houses
R-2	Yes	-	KD pistol with bullet trap
R-3	*Indoor only*	-	*MATCH shoot house (fully indoors); not assessed under REVA*
R-4	-	-	*Bivouac and instruction area (no munitions use); not assessed under REVA*
R-5	Yes	Yes	Multi-purpose and maneuver; small arms into on-range targets or impact areas; non-small arms into impact areas
R-6	Yes	-	KD pistol with SACON® wall and bullet trap
R-7	Yes	Yes	Multi-purpose static into impact areas
R-8	-	Yes	Light demolitions
R-8A	-	-	*SACON® shoot house (former use)*

Range	Current Use		Notes
	Small Arms	HE	
R-8B	Yes	Yes-	Rifle point man course (new range)
R-9	Yes	-	Multipurpose static and table fire into earthen berm or non-dudded impact area
R-9A	-	Yes	Mortar pit firing points into HE impact area
R-10	Yes	-	High-angle rifle fires from top of Ulupau Head into non-dudded impact area
R-11	-	Yes	Grenades (new range); hand grenades into pit on range and launched grenades into impact area.

Italics indicates no current use or not assessment under REVA
KD – known distance
MATCH - Modular Armored Tactical Combat House
SACON® - shock-absorbing concrete

Most of the ranges are located within the base of the crater. These include R-1, R-2, R-6, and R-9 (small arms); R-9A (mortar firing points); R-5 and R-7 (multi-purpose); and R-11 (grenade). The R-2 and R-6 SARs both have bullet traps, and R-9 has an earthen impact berm. Use of R-1 changed during the current review period. It was only a known distance (KD) range during the previous review, but it currently has moving and stationary targets (including shock-absorbing concrete [SACON®] blocks) as well as six remaining KD lanes. R-11 is a new grenade range.

Three ranges are not located within the base of the crater: R-10, R-8, and R-8B. R-10 (high angle rifle range) fires from the top of the Ulupau Head into the crater. R-8 and R-8B (demolition range and point-man's course [new], respectively) are within a ravine closer to sea level.

Three ranges at KBRTF are not assessed under the current REVA. R-3 is indoors (not eligible for review under REVA), R-4 is a bivouac area where no live fire occurs, and R-8A had no munitions use during the current review period. R-8A is a SACON® shoot house that is currently undergoing repairs. It is located northeast of R-7 on a slope between the base of the crater and the R-8 ravine area.

One new range is planned for live fire at KBRTF. The range consists of trenches that have been constructed within the base of the crater. No use occurred during the current review period, as the range had not yet been authorized for live fire as of the January 2020 REVA site visit.

4.1.1.2 PRTF

PRTF has six SARs: Alpha and Bravo are KD rifle ranges; and Charlie, Delta, Echo, and Foxtrot are pistol ranges. Additionally, an annex north of the access road extends Alpha Range for use up to 1,000-yard firing. There have been no significant changes in use or configuration since the previous REVA review.

The ranges are parallel to each other and oriented to fire from the north to the south-southeast into berms. On the back side of the impact berms are a vegetated dune, sand beach, and the ocean. The ranges are separated from each other by vegetated side wall berms. Alpha and Bravo Ranges have a tiered berm design on the front starting at the base with target systems on the range floor, a sloped lower base/support berm, a flat berm access lane, a 1:1 slope impact berm, and topped with a ricochet wall. The backs of the berms are a single slope facing the ocean. Charlie through Foxtrot have a single berm design with target systems on the range

floor, a 1:1 slope impact berm, and a single slope on the back facing the ocean. Irrigation/sprinkler systems are present for all berms to support vegetation growth to limit erosion.

4.1.2 Expenditure Data

The USMC tracks munitions expenditures in RFMSS for each training range and impact area. RFMSS expenditure data for the current reporting period were obtained from MCB Hawaii range personnel for the period 1 Jan 2014 - 10 Mar 2020. In order to compare munitions use during this reporting period to that of the Five-year Review, annual average expenditures were calculated. To calculate the annual average number of munitions fired at each range for the current reporting period, the total number of munitions fired at each range were divided by the length of the reporting period (6.2 years) to represent one average year.

The Five-year Review Report states that RFMSS data from Jan 2008 to Feb 2013 were used to calculate average annual expenditures. Additionally, Explosive Ordnance Disposal (EOD) records from Jan 2010 to Feb 2013 were used to estimate additional expenditures that were not captured in RFMSS (USMC, 2014).

4.1.2.1 Small Arms and Explosives Use

The total average annual small arms expenditures for the entire MCB Hawaii increased from the previous review period to the current review period. Small arms expenditures at KBRTF increased, while PRTF expenditures slightly decreased. The SAR with the highest use and the largest increase in use at MCB Hawaii is R-6 at KBRTF. However, as mentioned in Section 4.1.1, R-6 uses a bullet trap. Refer to Section 4.1.3 for additional information regarding the range management activities that limit off range migration of MC.

Explosives are used only at the KBRTF at MCB Hawaii. The total average annual explosives expenditures for KBRTF increased from the previous review period to the current review period. Overall, HE use at KBRTF remains low.

4.1.2.2 Perchlorate-containing Munitions Use

At MCB Hawaii, perchlorate-containing munitions are used in low quantities at KBRTF. The average annual number of perchlorate-containing munitions expenditures from the previous to current review periods decreased by approximately half, but the mass of perchlorate expended remained similar.

During the previous and current review periods, the largest number of perchlorate-containing items expended was at R-5 from practice grenades, though these expenditures significantly decreased since the last review. During the current review period, the highest mass of perchlorate at KBRTF was associated with simulators and HE mortars.

4.1.3 Range Maintenance

Range maintenance was performed at the KBRTF and PRTF during the current review period. Activities included MC source removal via operational range clearance, as well as minimization of off range MC migration via berm maintenance and revegetation.

4.1.3.1 KBRTF

Operational range clearance was performed at R-8 in 2015. This included surface and subsurface (to two feet) removal of Munitions and Explosives of Concern (MEC) over a 200 square foot area. Subsurface MEC items and munitions related scrap were recovered and disposed (NAVFAC Pacific, 2015c).

Operational range clearance was performed on 30.8 acres at KBRTF in 2017 and included surface and subsurface removal of MEC, Materials Potentially Presenting an Explosive Hazard (MPPEH), and other ordnance scrap or target debris. MEC/MPPEH items were encountered and destroyed via demolition. After inspection, Materials Documented as Safe (MDAS) were removed and sent offsite for metals recycling (NAVFAC Pacific, 2018).

According to installation personnel, operational range clearance occurred on the SAR impact berms for R-2, R-6, and R-9 in late 2019. At R-2 and R-6, the rubber granules were removed, screened for lead, and returned. At R-9, the soil was excavated, screened for lead, and then returned to the berm. Jute matting and hydroseeding were applied over the soil berm, and a sprinkler system was used to support vegetation growth. These actions effectively removed much of the accumulated MC source (lead) from the impact berms.

4.1.3.2 PRTF

The berms for all ranges at the PRTF were mined for lead, graded, and revegetated during the current review period. Each range was mined for lead at least once during the review period. Lead was recovered and transported for recycling off island. Berms were reconstructed with existing and new soil, jute erosion control mats and hydro-seeding were installed, and sprinkler systems were repaired where necessary (NAVFAC Pacific, 2015a, 2016, and 2019).

4.1.4 Summary of MC Source Areas

The average annual expenditures for MCB Hawaii were categorized by munitions type as small arms (potential source of lead as a REVA indicator MC) or explosives (potential sources of RDX, HMX, TNT as REVA indicator MC). Viable MC sources are present at KBRTF (lead, explosive constituents, and perchlorate) and PRTF (lead only) at MCB Hawaii. Minimal perchlorate-containing munitions items are used at MCTAB and do not constitute a viable MC source. Due to the absence of any substantial MC sources, the CSM pathways are incomplete for MCTAB.

There is an overall increase from the previous review period to the current review period for small arms expenditures at MCB Hawaii, which can be attributed to an increase in training at KBRTF. Small arms expenditures at R-6 account for more than one-third of the total small arms expenditures at MCB Hawaii. However, munitions and associated MC from R-6 are likely to remain on range due to the use of a bullet trap. Small arms use is also concentrated at the PRTF ranges, where small arms use slightly decreased during the current review period. Range maintenance and lead mining occur frequently at PRTF, and the earthen impact berms are well-vegetated due to the presence of sprinkler systems.

Expenditures of HE munitions increased from the previous review period to the current review period. However, the overall use of HE items at KBRTF is relatively low.

Expenditures of perchlorate-containing munitions at KBRTF decreased from the previous to current review periods. Highest use was recorded at R-5 during the previous review, but expenditures at that range significantly decreased during the current review period. Overall use of perchlorate-containing items at KBRTF is relatively low.

4.2 Transport Mechanisms

A CSM transport mechanism is a method in which MC in the secondary source/media (surface water or surface soil in the MC deposition area on range) travels to exposure media (surface water, sediment, surface soil, or groundwater) off range.

The MC primary source areas at MCB Hawaii are land-based munitions impact areas within the KBRTF and PRTF. No munitions are expended directly into water (i.e., water bodies are not used as a munitions target or range impact area), so surface water as a secondary source/media is an incomplete pathway.

The remaining transport mechanisms are for MC in surface soil or stormwater traveling off range via runoff (overland flow) or infiltration/percolation to groundwater. These are discussed further in Sections 4.2.1 and 4.2.2, respectively.

4.2.1 Stormwater Runoff and Soil Erosion

There are no permanent freshwater bodies or streams at KBRTF or PRTF. When rain events occur, stormwater either evaporates, or at PRTF, quickly infiltrates into surficial soils.

At KBRTF, stormwater runoff generally flows from the high points on the south, west, and north into the Kailua Bay on the east (off range). In the southern portion of KBRTF, overland flow is generally from the Ulupau Head on the south and west toward the east-southeast into the bay. This area receives most of the runoff from the firing points and SARs, though runoff is minimal. The northern portion of KBRTF receives runoff from most of the MC source areas and has a radial drainage pattern from the Ulupau Head on the west and Mokapu Point on the north into an unnamed drainage ravine near the center of the crater, which leads into the bay. The primary unnamed drainage is labeled on Figure 4a. A smaller drainage is located to the north that meets the primary drainage just before it reaches Kailua Bay. Another smaller drainage is located to the east and drains portions of the Dudded impact area.

At PRTF, the topography is flat (Figure 4b). Due to the configurations of the ranges with berms along the ocean and side wall berms separating each range, stormwater runoff is generally impounded within the range footprints. However, future shoreline erosion is a concern at PRTF.

The following subsections summarize influences on runoff and erosion including precipitation, soil types, known coastal erosion areas, and engineering controls at SARs.

4.2.1.1 Precipitation

MCB Hawaii has a temperate oceanic climate, with very little variation in temperature either seasonally or daily. Generally, the most precipitation occurs in the winter months, while the summer months are drier. Table 4-2 shows annual precipitation data for the current review period available from select weather stations near the KBRTF and PRTF.

Table 4-2: Annual Precipitation (NOAA, 2020)

Area	Weather Station		Annual Precipitation (inches)					
	Name	Location	2014	2015	2016	2017	2018	2019
KBRTF	KAILUA 3.1 N	0.5 miles southwest	NA-	25.89	NA	NA	NA	NA
	KANEOHE BAY MCAS	2.5 miles west	23.84	10.87	8.4	21.18	NA	NA
PRTF	HONOLULU OBSERV. 702.2	0.5 miles west	22.01	14.54	9.99	26.08	39.45	18.91

NA: Not applicable. No data reported.

Higher annual rainfall totals and storms are more conducive to stormwater runoff, both of which occur at MCB Hawaii. As shown in Table 4-2, precipitation ranged from low (8 inches per year) to moderate (39 inches per year). At KBRTF, the closest weather station to Ulupau Crater recorded 26 inches of precipitation in 2015, which was the only full year of data available during the current review period. A nearby weather station (approximately 2.5 miles west of Ulupau crater) recorded annual precipitation ranging from 8 to 24 inches for the years 2014 through 2017. A coastal weather station approximately 0.5 miles west of PRTF recorded precipitation ranging from 10 to 39 inches during the current review period (National Oceanic and Atmospheric Administration [NOAA], 2020).

4.2.1.2 Soil

The topography at KBRTF is characterized by rugged, steep terrain that is close to the coastline. Surface soils in the southern portion of KBRTF generally consist of clay with low permeability, high runoff potential, and moderate erodibility. Soil pH tends to be near neutral at 7.6. Acidic soils generally are more conducive to leaching lead. The northern portion of KBRTF is characterized by outcrops of volcanic tuff rock, including rock outcrops in the ravines inside the crater. The soils are silts and clays with high runoff potential, a neutral pH of 7, and a low soil erodibility factor (USMC, 2014).

The topography at PRTF is characterized by flat, beachfront terrain. Surface soils are sandy/gravely (coral outcrop) with high permeability and low runoff potential. Based on nearby soils, pH at the PRTF is expected to range from 6.7 (slightly acidic) to greater than 9.0 (basic) (USMC, 2014).

4.2.1.3 Shoreline Erosion: KBRTF

At KBRTF, known erosional hot spots are present within the Ulupau Crater and are monitored by installation personnel. During the January 2020 REVA site visit, the KBRTF generally was well-vegetated. However, erosion was noted on the steep cliffs near the impact areas and in the unnamed drainage area. Future projects are proposed to design and implement solutions to control erosion and sediments flowing off range.

Several wildland fires have occurred at the KBRTF during the current review period as well as during previous review periods. Slopes left denuded by fire are particularly susceptible to accelerated erosion. Table 4-3 shows the number of fires and acres burned each year.

Table 4-3: Burned Acreage at KBRTF (USMC, 2017)

Calendar Year	Number of Fires	Acres Burned
2012	1	1.396
2013	2	0.644
2014	4	4.066
2015	4	4.323
2016	3	11.804

The fires noted in Table 4-3 occurred near the dudded and non-dudded impact areas and partially within the Ulupau WMA. Dry invasive grasses and strong trade winds increase the threat and spread of wildland fires. A variety of techniques are employed at KBRTF to minimize wildland fires. Herbicide is applied along range roads to control invasive grasses and limit fire fuel. Fuel breaks and firebreaks are maintained within the impact area to reduce the risk of fire spread. In late 2019, the firebreaks in the live impact area and around the red-footed booby bird colonies were maintained and expanded, including grading, widening, connecting gaps, and adding 600 tons of gravel to the firebreaks. Four water cannons are located in the Ulupau WMA directed toward the impact areas. They are used to protect the red-footed booby bird colony population and habitat by quickly suppressing any wildfires in the vicinity. Maintenance and operation of the cannons is challenging due to the unusual technology employed (USMC, 2017). Installation representatives indicate that they are currently partially functional.

4.2.1.4 Shoreline Erosion: PRTF

The earthen berms of the PRTF are located less than 100 feet from the beach. While the backsides of the berms are well vegetated, there are no additional structures or protections between the berms and the beach.

Periods of erosion and shoreline recession at PRTF have been noted over many years. MCB Hawaii previously addressed shoreline erosion and restoration of vegetation and irrigation in 2000. The vegetation functioned well until about 2014, when increasing erosion led to a steepening of the slope and undermining of approximately 90% of the vegetation (USMC, 2019a). Immediately east of the PRTF at Keahi Point, approximately 300 feet of shoreline recession has occurred over the last 60 years. The Iroquois Point beach nourishment and stabilization project, located about 500 feet east of the PRTF, included construction of nine T-head groins along the beach in 2013. The shoreline profiles were surveyed annually for four years post-construction. Surveys indicated that the shoreline along the eastern half of PRTF was moved seaward (accreted) or remained unchanged. The western half moved landward (receded) for the first two years, and then showed little change for the following two years (USMC, 2019a).

On behalf of the USMC, the Naval Facilities Engineering Command Pacific prepared an Environmental Assessment in August 2019 to initiate measures to mitigate coastal erosion at PRTF (USMC, 2019a). The Preferred Alternative (PA) consisted of installing sheet pile along the fast land boundary of Ranges Alpha and Bravo; a maximum-feasible retreat/setback from the shoreline of Ranges Charlie through Foxtrot; and revegetating available fast land areas fronting all ranges, as feasible. The sheet pile would be installed on the ocean side of the ranges to mitigate erosion to the toe of the impact berms. It would wrap-around the eastern and western edges of the range impact berms in order to provide erosion protection at the ends of

the berms. To prevent manmade erosion over time at the training facility, the PA also includes beneficial landscape treatment consisting of plants, protective fencing, and walkways. Although the PA would initially disturb wildlife when vegetation is cleared, the PA site does not provide unique or sensitive habitat or wildlife, and any disturbed species could relocate to similar habitat nearby. Additionally, the relocation of the short-distance ranges would have beneficial long-term impacts, since it would move the existing berms farther from potential future sea level rise and prevent degradation to the berms caused by reflection of wave energy (USMC, 2019a). The PA will be implemented in phases and is dependent on available funding. In the first phase, MCB Hawaii will implement projects to revegetate available fast land areas fronting all ranges, while continuing to monitor shoreline erosion. In the second phase, MCB Hawaii will move the short-distance ranges (Ranges Charlie through Foxtrot) back from the shoreline. This phase includes installation of backstop berms, structures, and utilities as necessary. MCB Hawaii will continue to monitor conditions following implementation of the first two phases and will conduct additional technical and environmental studies in the event there are substantial new circumstances or information relevant to environmental concerns that bear on the PA.

4.2.1.5 Engineering Controls at SARs

The highest use SAR is R-6 at KBRTF. This range has a bullet trap, which significantly limits the potential for transport of lead via runoff into the nearby Kailua Bay. R-2 also uses a bullet trap. R-9 has an earthen impact berm and SACON® wall at the base. The range underwent operational range clearance in 2019. During the January 2020 REVA site visit, the berm face was covered in intact netting and vegetation had not yet returned following clearance activities. Runoff from the berm face would flow east toward the bay or north into the unnamed drainage feature via a gravel road. A corrugated plastic ditch with a flat bottom runs parallel to the gravel road (Figure 4a). The lined ditch prevents further soil erosion along the road and slows some stormwater runoff.

At PRTF, the configuration of the ranges (Sections 4.1.1.2) and the range maintenance activities previously described (Section 4.1.3.2) reduce soil erosion and limit the amount of stormwater runoff reaching the nearby ocean. Each range has an earthen impact berm, but the connecting design of the impact berms and side berms generally keeps runoff from the face of the berms within the footprint of each range. Each range has a sprinkler system to support vegetation growth along the berm face, which reduces soil erosion. The backsides of the berms (facing the ocean) are well vegetated.

4.2.2 Infiltration/Percolation to Groundwater

A transport mechanism for MC in surface soil on the range or impact area to off range areas is via infiltration or percolation to groundwater. Groundwater flow at KBRTF and PRTF is generally toward the coastline. The groundwater table is anticipated to be just above sea level at both facilities. Elevations at the base of the Ulupau Crater range from approximately 200 feet above sea level to 20 feet above sea level at the cliffs on the eastern side. Surface soil permeability at the KBRTF is low, which limits potential migration downward to the water table.

The PRTF is near sea level (less than 10 feet above sea level). Surface soils generally are permeable; therefore, MC have the potential to migrate downward with infiltrating water to the water table. The water table is shallow and groundwater discharges into the ocean (USMC, 2014).

Groundwater aquifers underlying the KBRTF and PRTF are located seaward of the Hawaii Underground Injection Control (UIC) Line and are designated as nondrinking water aquifers (Figure 5). Groundwater at both facilities is expected to be brackish to saline (USMC, 2014).

4.2.3 Summary of Transport Mechanisms

MC are deposited onto surface soil at the KBRTF and PRTF during training. MC is most likely to travel to off range areas (bay/ocean) via stormwater runoff at KBRTF and via infiltration/percolation to groundwater at PRTF. There are no permanent surface water bodies in the ranges and impact areas (where MC are deposited); therefore, surface water does not serve as a secondary source/media in the CSM.

At KBRTF, the primary source of MC migrating off range is via stormwater runoff and erosion from the impact areas in the vicinity of the unnamed drainage area into the Kailua Bay. Rainfall totals are low to moderate, topography is steep, and soils have high runoff potential and low to moderate erodibility. These conditions are conducive to MC migration via stormwater runoff and soil erosion into the Kailua Bay, especially from unvegetated areas. Therefore, stormwater runoff is a potential migration pathway. Evaporation rates are high, and some surface soils at KBRTF have low permeability, so infiltration to the water table is expected to be limited. Groundwater from KBRTF likely discharges into the surface waters of the Kailua Bay.

At PRTF, the primary source of MC migrating off range is from impounded stormwater from the front of the berms that infiltrates to the groundwater table and flows into the ocean. Topography is relatively flat with connecting impact and side berms that limit runoff to areas outside the range footprint. Rainfall totals are low to moderate and surface soils have high permeability. These conditions are conducive to MC migration via infiltration to the shallow groundwater table with subsequent discharge into the ocean. Therefore, infiltration to groundwater is a potential migration pathway.

4.3 Off Range Receptors

As summarized in Section 4.2.3, viable MC sources and transport mechanisms are present for stormwater runoff at KBRTF and for infiltration to groundwater at PRTF. The third component of a complete CSM pathway is receptor interaction with the media at an off range location. Off range areas are outside the operational range complex boundary. The range complex includes ranges, impact areas, and training areas. Receptors include humans or biota that interact via ingestion, incidental ingestion, or dermal contact with media (i.e., sediment, soil, surface water, groundwater). For KBRTF and PRTF, the nearest off range areas are marine water bodies (Kailua Bay and Pacific Ocean, respectively).

MCB Hawaii encompasses approximately 4,500 acres across eight properties containing forest, wetland, coastal dune, marine, and urban environments. These habitats support nine federally listed and two state-listed threatened or endangered species including plants, birds, an insect, and marine life. The installation also hosts over 50 species of native and migratory birds. A summary of off range human and ecological receptors at KBRTF and PRTF are presented below. Potential on range ecological receptors, such as the red-footed booby, are also discussed for KBRTF.

4.3.1 KBRTF

At KBRTF, the off range boundary for ecological receptors is the intertidal/littoral zone in the Kailua Bay. For human receptors, a 500-yard Naval Defense Sea Area Buffer extends from the shoreline into the Kailua Bay, restricting access to the nearshore area. Therefore, the off range boundary for human receptors is approximately 500 yards offshore.

The Kailua Bay is subject to mixing with daily fluxes of large volumes of tidal water. The tidal mixing is expected to provide significant dilution of stormwater runoff and discharging

groundwater from the range complex. Soil from the range complex may be deposited in the nearshore areas (USMC, 2014).

4.3.1.1 Human Receptors

Potential human receptors for surface water and sediment may include recreational users on the shoreline near the facility (special access required) or recreational users in the water beyond the Naval Defense Sea Area Buffer (500 yards from shore). Use of the shoreline near the ranges at the KBRTF is mostly restricted, but several areas have reserved access with special approval; use is infrequent. The majority of the 500-yard buffer is restricted (USMC, 2017). Areas at which exposures could occur are difficult to access by Marine Corps personnel attempting to fish, dive, or boat in the area (USMC, 2014).

Groundwater aquifers underlying KBRTF are likely brackish to saline and are designated as nondrinking water aquifers. There are no drinking water groundwater wells used within or outside of the KBRTF. The nearest public water supply well is seven miles across Kaneohe Bay southwest of Ulupau Crater. (USMC, 2014).

4.3.1.2 Ecological Receptors

Ecological receptors may be present in areas downgradient from the KBRTF. They include coral colonies, sponges, bryozoans, sabellid worms and tunicates, burrow-dwelling gobies, abundant populations of 20 or more fish species, and a growing abundance of the threatened Hawaiian green sea turtle (USMC, 2014).

There are nine federally threatened or endangered species that are regularly present at MCB Hawaii (USMC, 2017). Two species are noted as occurring near KBRTF. The Hawaiian yellow-faced bee (*Hylaeus anthracinus*) is found on coastal native vegetation and the non-native tree heliotrope on the Mokapu Peninsula shorelines. The Hawaiian monk seal (*Neomonachus schauinslandi*) frequently hauls out on all Mokapu beaches. The beach and nearshore waters are surveyed prior to the start of certain training exercises. In 2015 and 2016, training events were canceled at KBRTF due to the observed haul-out of a Hawaiian monk seal (USMC, 2017).

Two migratory birds protected under the Migratory Bird Treaty Act are present at KBRTF: the Laysan albatross and red-footed booby. In 2013, a Laysan albatross chick fledged, and in 2015, one egg was relocated from a nest at KBRTF. A red-footed booby colony is located at the north end of Ulupau Crater. Water cannons are present near the impact areas in the Ulupau WMA to serve as a secondary fire suppression system and to protect the red-footed boobies from range fires. Several management actions have been taken to support the continued sustainability of the red-footed booby colony, including tree planting, nesting platform replacement, a relocation study, and expansion of the water cannon system (USMC, 2017). Additionally, in late 2019, maintenance and expansion of the firebreaks in the live impact area and around the red-footed booby colonies were performed to reduce fire spread, thus adding protection for the birds.

4.3.2 PRTF

The off range boundary for human and ecological receptors at the PRTF is the beach south of the impact berms and the associated nearshore area (Pacific Ocean). The tidal mixing of ocean water is expected to provide significant dilution of discharging groundwater potentially containing MC.

4.3.2.1 Human Receptors

Groundwater aquifers underlying PRTF are designated as nondrinking water aquifers, and there are no groundwater wells used at PRTF. Due to the proximity of the area to the ocean, the

groundwater is brackish to saline and unsuitable for human consumption. Drinking water is obtained from the city/county distribution system. (USMC, 2014).

Potential human receptors for surface water (as groundwater discharges to surface water) are recreational users on the shoreline and nearshore area. The off range area immediately behind the berms is off limits to the public. Signs and partial fencing are present at the eastern and western boundaries to prevent trespassing. Guards are posted during range use to block access to the beach and nearshore area. Installation personnel noted that trespassers do occasionally access the area, but a new remote surveillance system is planned for detecting trespassers.

Residential areas are present west and east of the PRTF along the oceanfront. Ewa/Puuloa Beach Park, a public park owned by the County of Honolulu, is located approximately 500 feet west of the Alpha Range impact berm. The park is heavily used for swimming, surfing, and fishing. The Ewa Limu Management Area is located in the waters off Ewa Beach on the south shore of Oahu, and extends from the western edge of the PRTF to Muumuu Street, and from the shoreline to 150 feet seaward. The Ewa Limu Management Area preserves native limu, an edible algae. Restrictions are in place allowing native Hawaiians to hand-pick up to one pound of all types of limu combined per person per day from 6:00 am to 6:00 pm during the months of July, November, and December (State of Hawaii Division of Aquatic Resources, 2020).

The offshore marine environment that borders the southern boundary of the complex is an important resource used for recreation and subsistence fishing. According to installation personnel, Puuloa Beach Park only allows catch and release fishing, and very few community members are given access to the shoreline to fish.

4.3.2.2 Ecological Receptors

The entire PRTF is comprised of modified landscape with no notable ecological communities on or adjacent to the property except for a few scattered native vegetation species on the beach, none of which are listed as threatened or endangered (USMC, 2014). The pueo (*Asio fammeus sandwichensis*) is an endemic short-eared owl that is state-listed as endangered. It may occasionally use the open portions of the training area for hunting. The PRTF shoreline infrequently hosts federally endangered Hawaiian monk seals and federally threatened Hawaiian green sea turtles. Four monk seals and nine green sea turtles were reported at the PRTF beach by range personnel in 2019. When a seal is reported, a protection zone and signage are established to limit interactions with humans.

There are no areas at PRTF designated as critical habitat by the federal government or the State of Hawaii (UMSC, 2019a). Installation personnel noted that there is an Essential Fish Habitat (EFH), but this consists mostly of colonies approximately 0.5 miles off the coast and minimal coral close inshore.

4.3.3 Summary of Off Range Receptors

At KBRTF, sensitive ecological receptors may be present within the intertidal/littoral zone of Kailua Bay, which receives stormwater runoff from the range complex. The Hawaiian monk seal (endangered) has been observed occasionally at the KBRTF, and coral is present within the 500-yard buffer zone. Potential human receptors include those that use the bay for recreational purposes, although public access is restricted by a 500-yard Naval Defense Sea Area Buffer. The Kailua Bay is subject to tidal mixing, which significantly dilutes runoff. Groundwater is not used at the KBRTF, and the underlying aquifers are designated as nondrinking water aquifers.

At PRTF, the beach behind the impact berms is restricted from recreational users. Recreational users are present on the shore east and west of the PRTF, and native Hawaiians may harvest edible limu from the nearshore areas west of the PRTF. Groundwater is not used at the PRTF, and the aquifers underlying the PRTF are designated as nondrinking water aquifers. The pueo (endangered) may occasionally use the area for hunting, and the Hawaiian monk seal (endangered) and Hawaiian green sea turtle (threatened) occasionally haul out on the shoreline at PRTF.

4.4 Pathway Completeness

Below is a summary of the pathway completeness for each facility at MCB Hawaii. This evaluation is based on the data gathered for the current review period for the MC source (Section 4.1), transport mechanisms (Section 4.2), and off range receptors (Section 4.3), as compared to the previous review period (Section 3). Figures 3a, 3b, and 3c provide graphical representations of the CSMs for each facility; all pathways were incomplete.

4.4.1 KBRTF CSM Summary

Small arms expenditures increased during the current review period at KBRTF. HE use at KBRTF slightly increased, but overall usage remains low. There were no significant changes to range configurations or transport mechanisms at the KBRTF. The most likely transport mechanism is stormwater runoff flowing into Kailua Bay in the vicinity of the unnamed drainage area. Infiltration to groundwater may occur, but groundwater is not used at KBRTF. Ecological receptors may be present in the nearshore areas of the Kailua Bay, but restrictions limit human receptors to 500 yards or more from the shoreline.

4.4.1.1 Lead

R-6 accounts for almost 75% of the small arms expended at KBRTF. The bullet trap at R-6 (and R-2) eliminates erosion at this range, thereby significantly reducing off range MC migration potential. Operational range clearance was conducted at R-2, R-6, and R-9 in 2019, which removed accumulated lead from these ranges. R-1 was reconfigured to remove some of the KD lanes and shoot into SACON® blocks, which capture projectiles and minimize off-range MC migration potential.

R-1, R-2, R-6, and R-9 were evaluated qualitatively during the previous review. This evaluation concluded minimal migration potential via surface water at R-2 and R-6 primarily because bullet traps are used to capture expenditures. A possibility of MC migration was indicated for R-1 and R-9, but the evaluation concluded there was no known immediate threat to human health or the environment. Expenditures decreased at these two ranges during the current review period.

4.4.1.2 Explosives and Perchlorate

Modeling conducted during the previous review period indicated that average annual MC concentrations at receptor locations were predicted to be either below detection levels or below screening criteria. While explosives use at the KBRTF did increase since the previous review, the increase is not sufficient to significantly change the modeled results. Use of perchlorate-containing munitions decreased during the current review period.

4.4.2 PRTF CSM Summary

Small arms use at the PRTF ranges decreased during the current review period. Lead mining and impact berm reconstruction during the current review period significantly reduced the lead source and erosion potential at PRTF SARs. There were no significant changes to range configurations or transport mechanisms at PRTF. The most likely transport mechanism is infiltration to shallow groundwater, which discharges to surface water (Pacific Ocean) where

mixing would reduce any MC concentration to below detectable levels. Surface runoff is unlikely due to the layout of the impact berms and side berms, which impounds stormwater on the ranges. The beach immediately behind the berms at PRTF is off limits to human receptors (recreational users); however, areas to the east and west are used for recreation, and the park to the west is used for harvesting limu. No threatened or endangered species are regularly present at or near PRTF, except occasional and infrequent visitors (Hawaiian monk seal, Hawaiian green sea turtle, and pueo).

A qualitative evaluation during the previous review identified potential lead migration into surface water from Foxtrot Range. During the previous review period, the impact berm was partially eroded, and its location along the shoreline threatened a release of MC into the ocean. During the current review period, small arms expenditures decreased at Foxtrot Range, and range maintenance was conducted including lead mining, berm reconstruction, sprinkler repair, and installation of erosion control measures. The berm at Foxtrot Range was observed to be in good condition during the January 2020 data collection site visit. The qualitative evaluations of the other PRTF SARs concluded there was not a known threat to human health or the environment for surface water or groundwater.

While no immediate threat is identified at PRTF, the six SAR impact berms are within 100 feet of the Pacific Ocean, and there are no additional structures or protections between the berms and the beach. Future shoreline erosion could cause the off range release of lead from the impact berms into the ocean. An Environmental Assessment was conducted in 2019 to initiate measures to mitigate coastal erosion at PRTF.

4.4.3 MCTAB CSM Summary

Only practice, blank, and simulator munitions are used at MCTAB. Expenditures during the previous review were very low (not enough MC source to carry through to modeling potential off range concentrations). Current range use is similar. Due to the absence of a substantial MC source, the CSM pathways are incomplete at MCTAB.

5 REVA Periodic Review Summary and Next Steps

Based on the available data for this review, the CSM pathways for migration of MC from the MCB Hawaii source areas to off range receptors are incomplete (Figures 3a, 3b, and 3c). The data collected for the MCB Hawaii REVA Periodic Review indicate that there is no known off range MC migration that presents a potential unacceptable risk to human health or the environment. Therefore, no further investigation (e.g., sampling, modeling) is warranted under the REVA program at this time. All ranges will be evaluated every five years or sooner if there are changes to site conditions.

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Attachments

Figures

Figure 1
MCB Hawaii
Installation Map

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

Installation Boundary

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services. MCB Hawaii

- ESRI World Imagery Service

Figure 2a
MCB Hawaii
KBRTF Ranges

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

- Impact Area - Dudded
- Impact Area - Non-Dudded
- Military Training Location
- Installation Boundary

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service

Figure 2b
MCB Hawaii
PRTF Ranges

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

Military Training Location

Installation Boundary

Note: R-A is referred to as Alpha Range, R-B is Bravo Range, etc.

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service

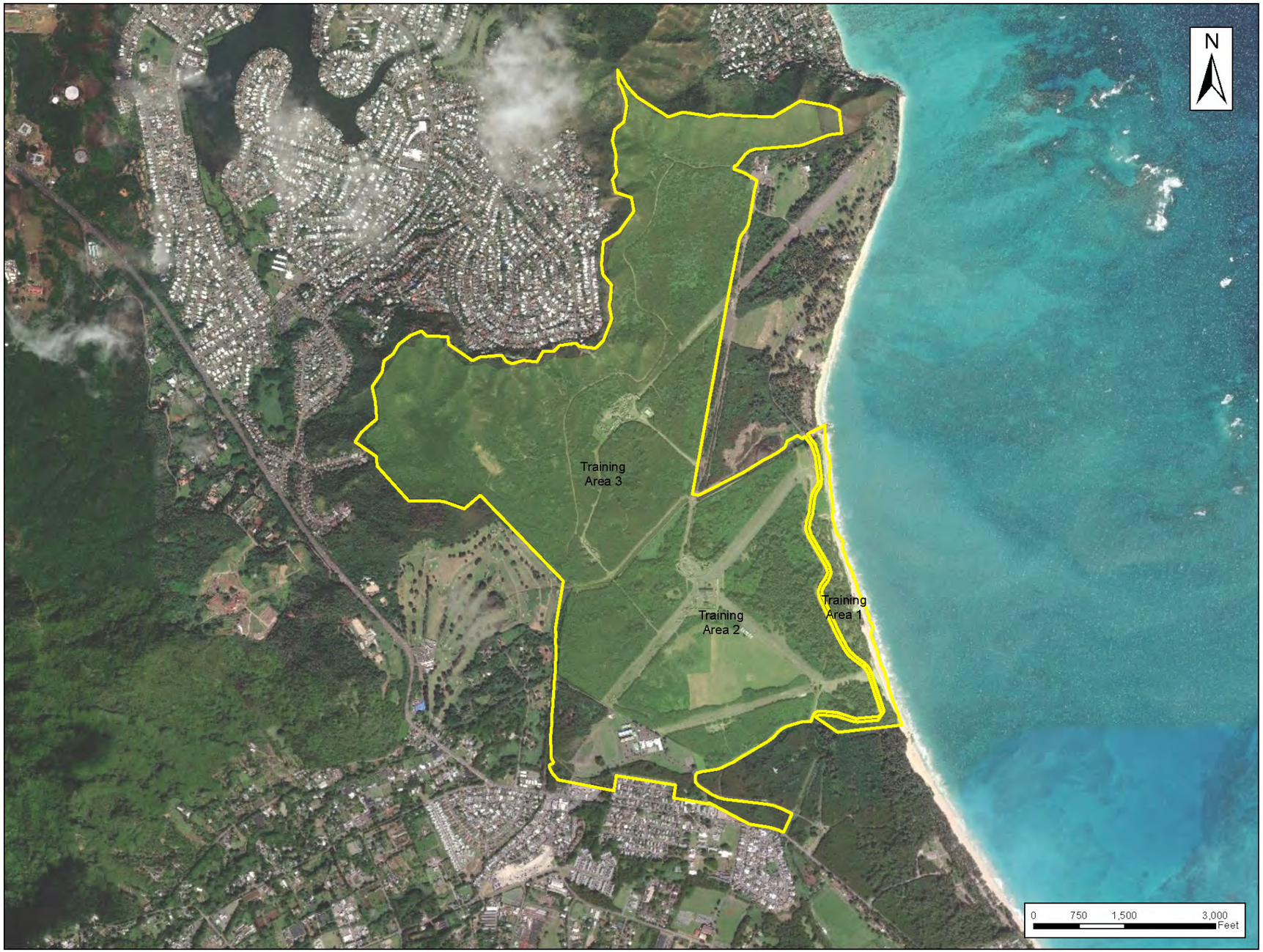

Figure 2c
MCB Hawaii
MCTAB Ranges

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

- Military Training Location
- Installation Boundary

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service

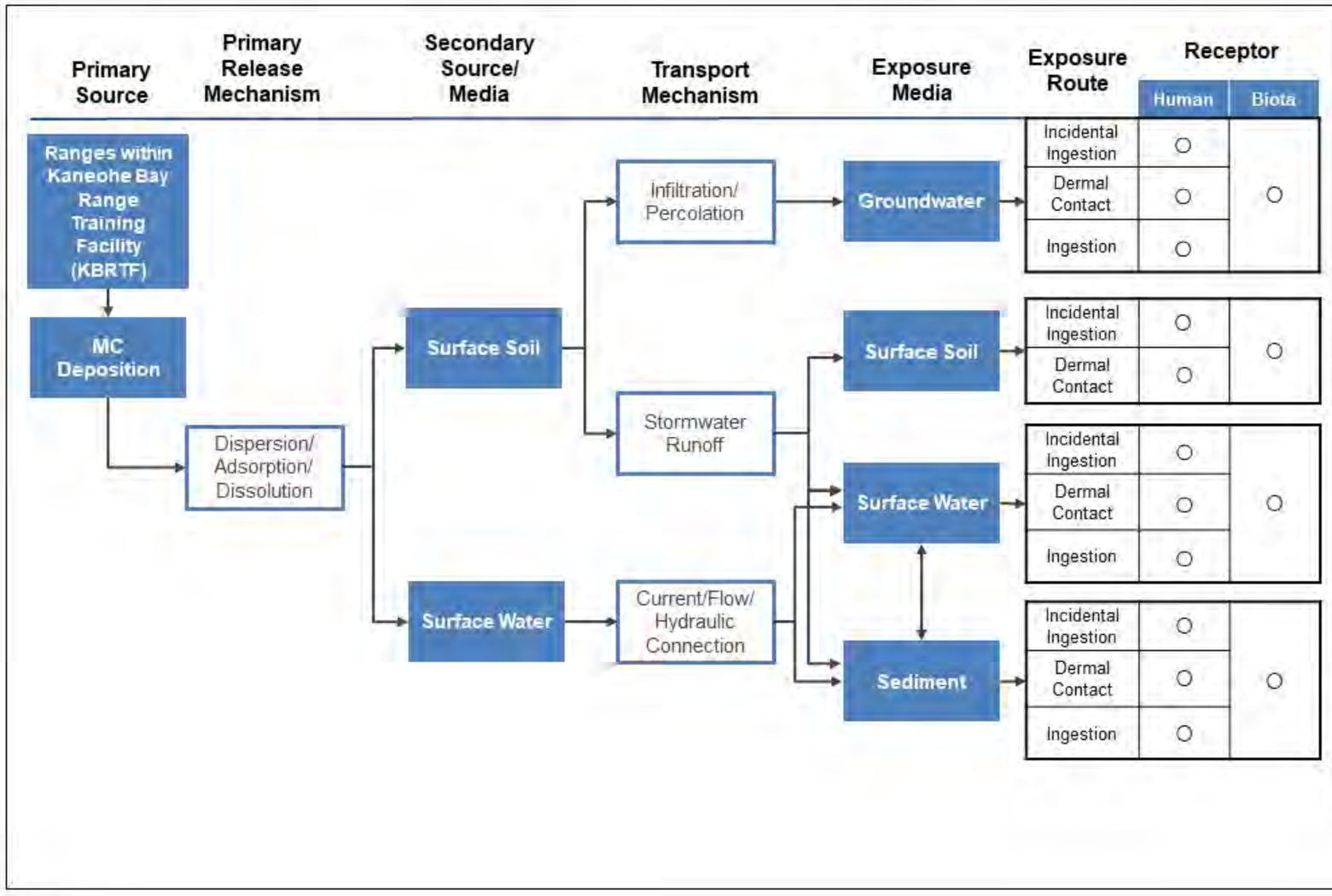

Figure 3a

MCB Hawaii CSM for Kaneohe Bay Range Training Facility (KBRTF)

Range Environmental Vulnerability Assessment
Periodic Review
MCB Hawaii
Oahu, HI

Legend

● **Complete:** Includes viable MC source(s), pathway(s), and receptor(s) and data indicate source/receptor interaction.

◐ **Inconclusive:** Includes viable MC source(s), pathway(s), and receptor(s) but there is insufficient data to conclude the pathway is either complete or incomplete.

○ **Incomplete:** Lacks viable MC source, pathway, or receptor OR data indicate there is no source/receptor interaction.

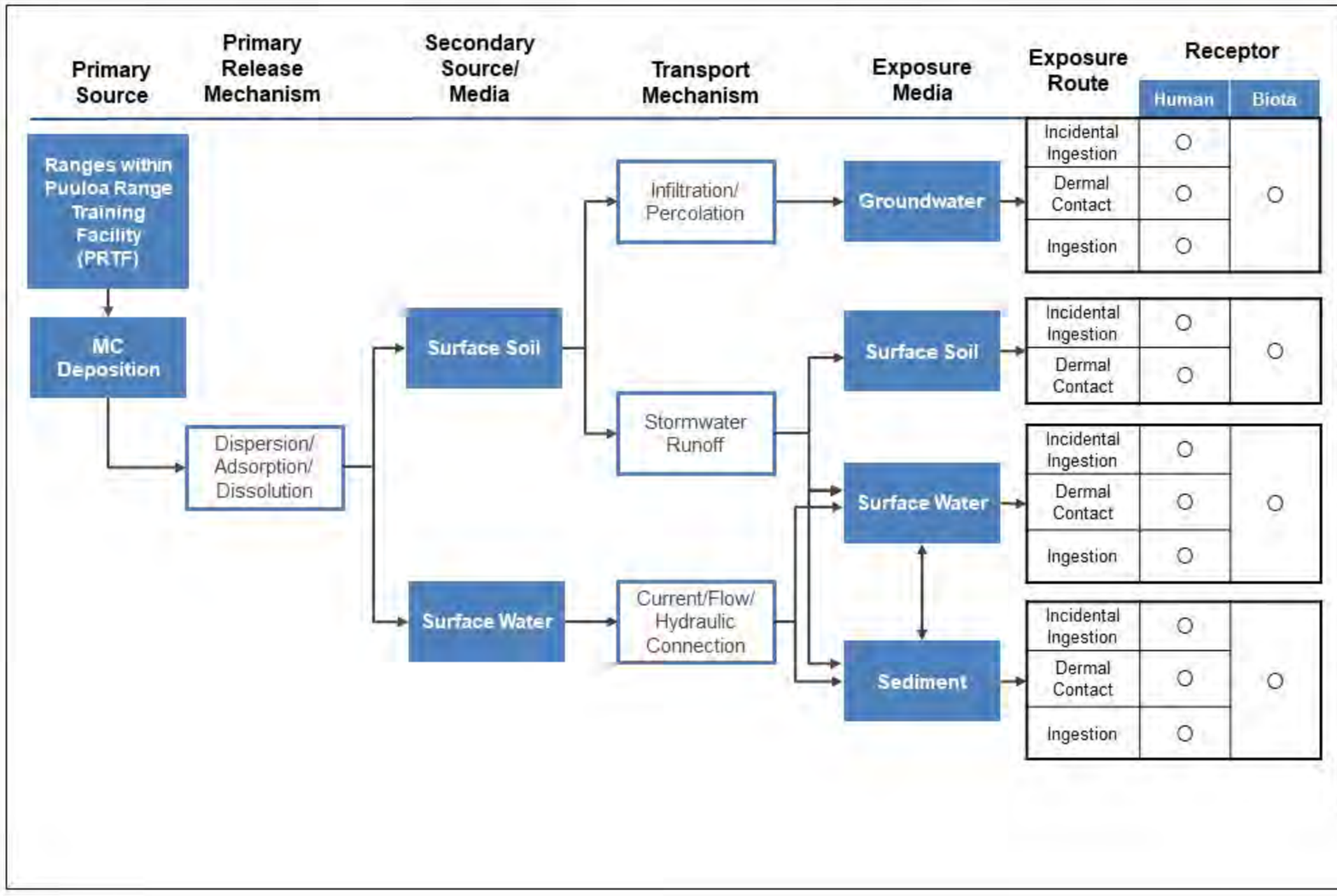

Figure 3b

MCB Hawaii CSM for
Puuloa Range
Training Facility (PRTF)

Range Environmental
Vulnerability Assessment
Periodic Review
MCB Hawaii
Oahu, HI

Legend

● **Complete:** Includes viable MC source(s), pathway(s), and receptor(s) and data indicate source/receptor interaction.

◐ **Inconclusive:** Includes viable MC source(s), pathway(s), and receptor(s) but there is insufficient data to conclude the pathway is either complete or incomplete.

○ **Incomplete:** Lacks viable MC source, pathway, or receptor OR data indicate there is no source/receptor interaction.

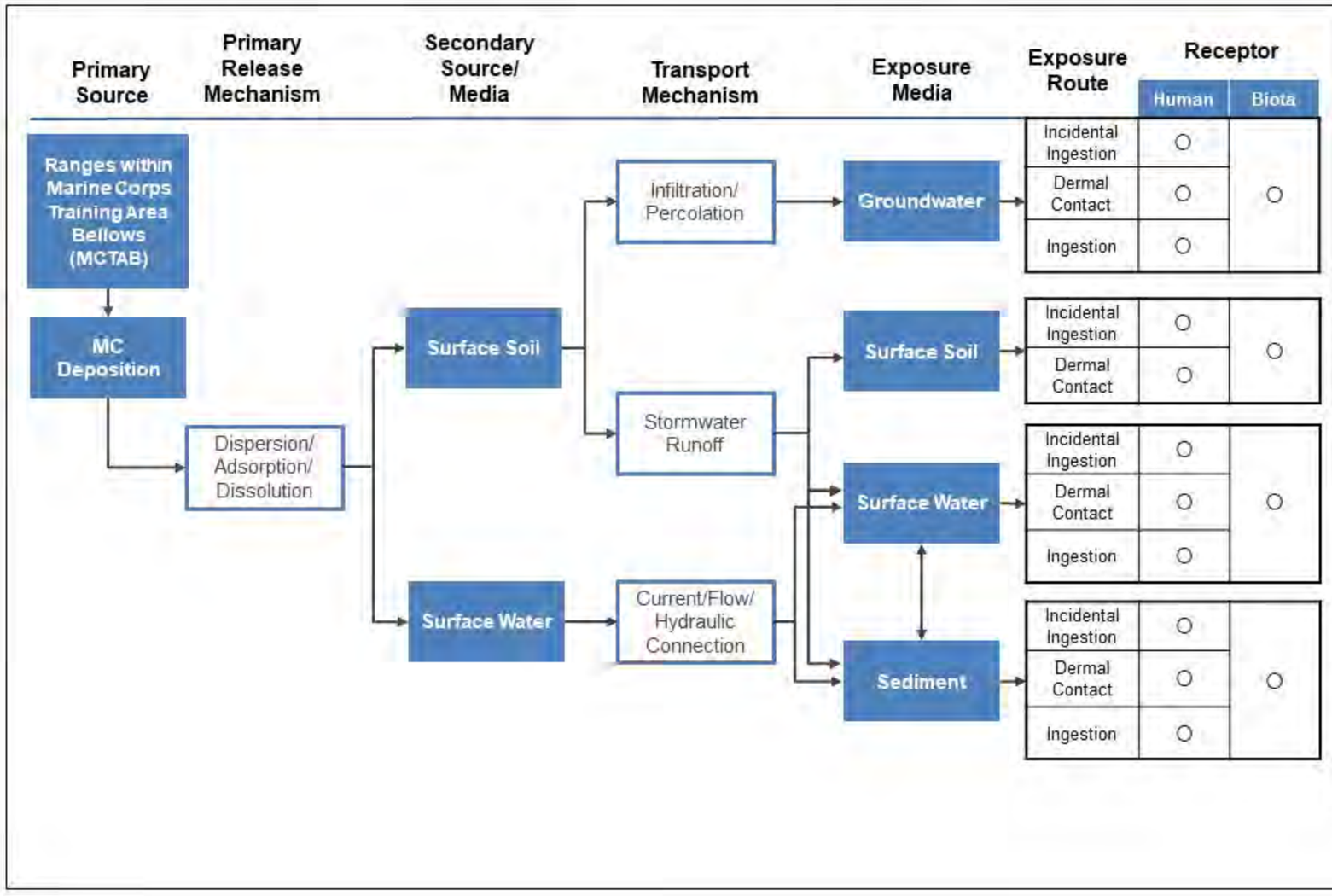

Figure 3c

MCB Hawaii CSM for Marine Corps Training Area Bellows (MCTAB)

Range Environmental Vulnerability Assessment
Periodic Review
MCB Hawaii
Oahu, HI

Legend

● **Complete:** Includes viable MC source(s), pathway(s), and receptor(s) and data indicate source/receptor interaction.

◐ **Inconclusive:** Includes viable MC source(s), pathway(s), and receptor(s) but there is insufficient data to conclude the pathway is either complete or incomplete.

○ **Incomplete:** Lacks viable MC source, pathway, or receptor OR data indicate there is no source/receptor interaction.

Figure 4a
MCB Hawaii
KBRTF Surface Water

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

- Installation Boundary
- Ulupau Wildlife Management Area

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service

Figure 4b
MCB Hawaii
PRTF Surface Water

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

Installation Boundary

Berm

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service

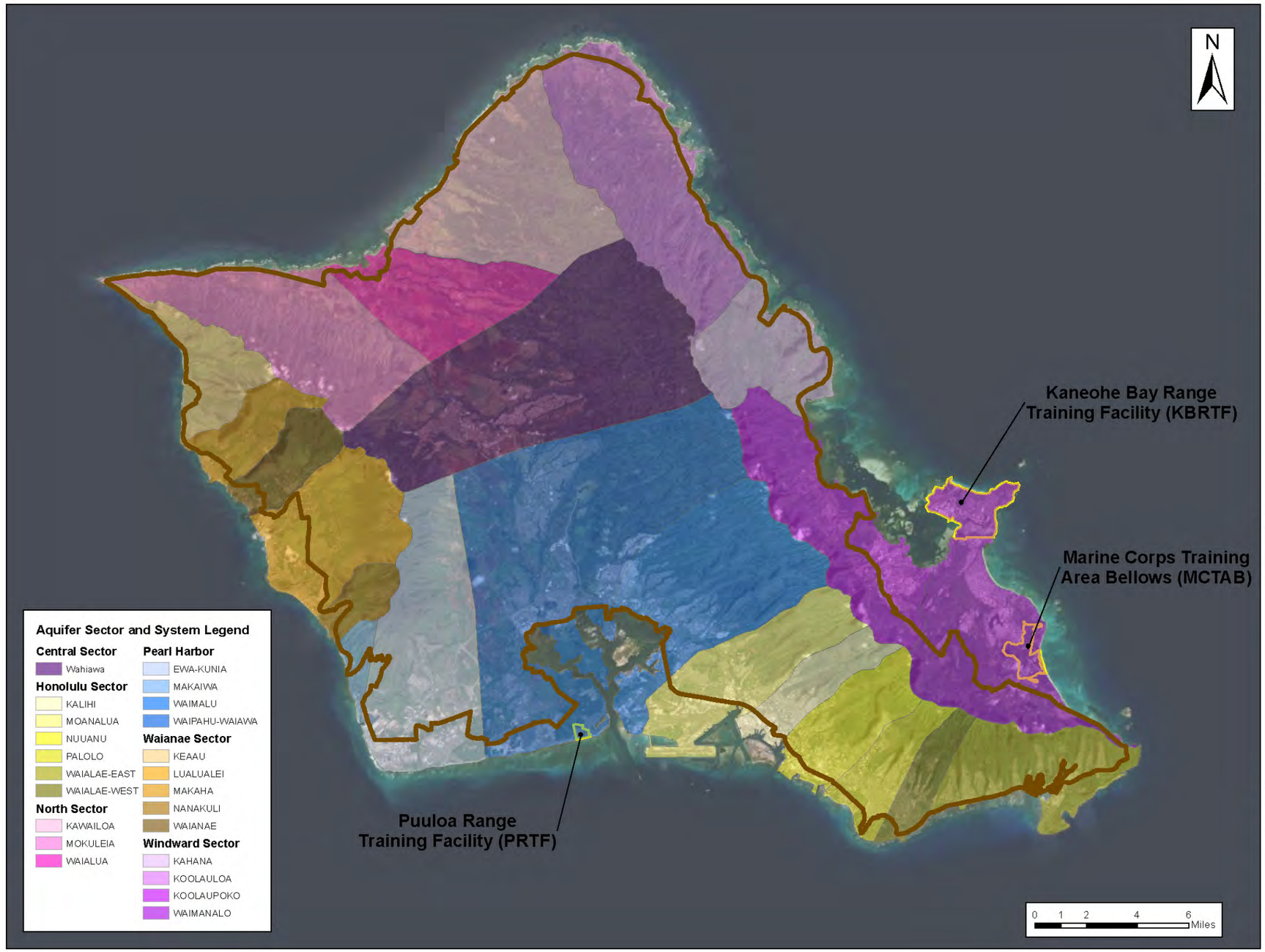

Figure 5
MCB Hawaii
Groundwater

Range Environmental Vulnerability Assessment
MCB Hawaii
Oahu, Hawaii

Legend

- Installation Boundary
- Underground Injection Control Line

Coordinate System: State Plane
Datum: NAD83 HARN
Units: Meters

Date: July 2020

-USMC Installation Geospatial Information & Services MCB Hawaii

- ESRI World Imagery Service, Hawaii State Office of Planning